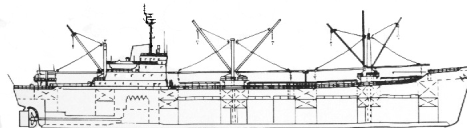


# Statewide Marine Auxiliary Engine Emissions Inventory

Oceangoing Ship Auxiliary Engine Rule Workshop  
August 24, 2005

Andy Alexis  
ARB Planning and Technical Support Division



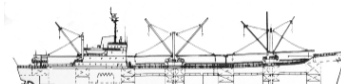
ARB/PTSD

August 24, 2005

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## Auxiliary Engine Emissions

- ♦ Auxiliary engine emissions occur close to human populations
- ♦ Why a statewide methodology?
  - Consistent methodology
  - Support ARB Programs
- ♦ Similar approach used for main propulsion engine emissions



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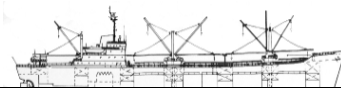
August 24, 2005

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## What is Needed?

- ◆ Base year emissions
- ◆ Future year Emissions
  - Uncontrolled (no proposed controls)
  - Controlled (proposed)
- ◆ Consistency

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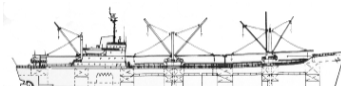


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## Vessel Operation Modes

- ◆ In-Transit
  - Main propulsion unit
  - Auxiliary engine
- ◆ Maneuvering
  - Main propulsion unit
  - Auxiliary engine
- ◆ Hotelling
  - Auxiliary engine

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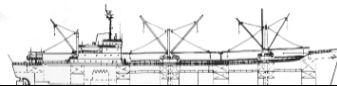


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# How are Emissions Calculated?

- ◆ Bottom-up approach
  - Vessel, trip, & port-specific
- ◆ Emissions = Act \* Pop \* EF
  - Act = Activity
  - Pop = Vessel population
  - EF = Emission factor
- ◆ Activity = Time \* Power \* LF
  - Time = Time-in-mode
  - Power based (i.e. kWhrs)
  - LF = Load Factor

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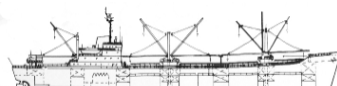


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# Hotelling Emissions

- Time-in-Mode by Port & Vessel Type
  - Hotelling times from 10.5 to 88 hours
- Auxiliary Engine Power by Vessel Type
- Load Factors by Vessel Type

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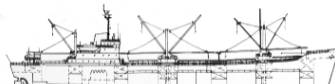


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# In-Transit/Maneuvering Emissions

- Time-in-Mode = Distance \* Speed \* Usage
  - Distance
    - ◆ Army Corps of Engineers shipping lanes
    - ◆ Link lengths between ports
  - Speed
    - ◆ By vessel type
  - Usage
    - ◆ When/how long aux. is used
- Auxiliary Engine Power by Vessel Type
- Load Factor
  - Survey data

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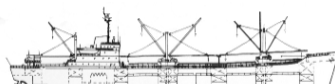


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# Activity Data Sources

- 2004 State Lands Commission Port Call Database
  - >10,000 port calls, 1,900 vessels
  - Previous/current/next port
  - Vessel name/type
  - Date
- Army Corps of Engineers
  - National Waterway Network, aka Shipping Lanes
  - 24 nautical mile zone

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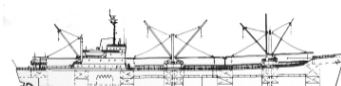


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## Load Factors, Power, Hotelling Times

- ◆ ARB 2005 Ocean Going Vessel Survey
- ◆ Port-Specific Data
- ◆ 2001 Port of Los Angeles Baseline Inventory (Starcrest)
  - Assigned by vessel type

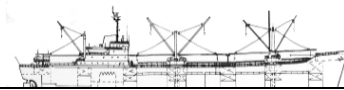


## Emission Factors:

- Assigned by fuel, mode and engine type
- Entec – EU Report
  - NO<sub>x</sub>: 10.9 – 13.9 gms/kWhr
  - SO<sub>2</sub>: 1.1 – 12.3 gms/kWhr
  - TOG: 0.4 gms/kWhr
- US EPA - PM
  - Heavy Fuel Oil: 1.5 gms/kWhr
  - Marine Distillate: 0.3 gms/kWhr

(above factors are for hotelling mode only)

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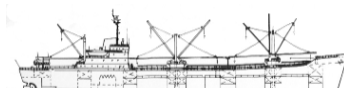


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## Fuel Assumptions

- Passenger Ships
  - 92% Residual Oil Usage
  - 8% Marine Gas Oil
- All Others
  - 72% Residual Oil
  - 28% Marine Gas Oil
- Source: ARB 2005 OGV Survey

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## Statewide Auxiliary Engine Emissions Estimates

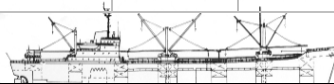
**Auxiliary Engine Emissions by Mode (tons/day) (2004 base year)**

Mode	PM	NOx	TOG	SOx	CO
<b>Hotelling</b>	1.7	19.8	0.6	14.6	1.5
<b>Maneuvering</b>	0.5	5.2	0.1	4.0	0.4
<b>Transit</b>	0.8	8.3	0.2	6.4	0.6
<b>Total</b>	<b>3.0</b>	<b>33.3</b>	<b>0.9</b>	<b>25.1</b>	<b>2.5</b>

**Main Engine Emissions by Mode (tons/day) (2004 base year)**

Mode	PM	NOx	TOG	SOx	CO
<b>Maneuvering</b>	0.1	0.5	0.1	0.4	0.1
<b>Transit</b>	5.7	68.2	2.3	40.2	5.3
<b>Total</b>	<b>5.8</b>	<b>68.7</b>	<b>2.3</b>	<b>40.6</b>	<b>5.3</b>

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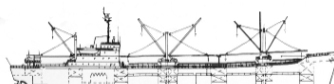


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## Future Year Emissions

- Future Emissions = EMS \* GF \* CF
  - EMS = Base Year Emissions
  - GF = Growth Factor
  - CF = Control Factor
- ARB Contract with Dr. J. Corbett, U. Delaware
- Installed Main Engine Power Surrogate
- Air Basin and Vessel Type Specific Growth Estimates

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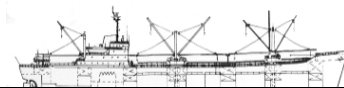


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## Next Steps

- ◆ Incorporate into ARB Inventory and Modelling
- ◆ Continue Discussions with Stakeholders/Districts
- ◆ Review inventory as new data available

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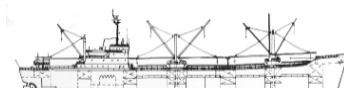


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## Schedule

- ◆ Ongoing: Gather Information from Stakeholders
- ◆ August 2005: Finalize Draft Inventory for Aux. Engine Reg. Proposal
- ◆ November 2005: Board Hearing

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August 24, 2005



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## Contact Information

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August 24, 2005

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